Scintillation Detectors to Improve Slim-Hole Gamma Ray Log Repeatability in Low Radioactivity Materials

by: Donald G. Hill, Weiss Associates, Bern Qualheim,
Lawrence Livermore National Laboratory

Abstract

Slim-hole gamma ray tools commonly use 1" X 4" NaI scintillation crystal detectors. These tools were originally developed and are best suited for high radioactivity environments such as those encountered in radioactive minerals exploration or, more recently, in sediments contaminated with radionuclides. Tertiary sediments in the Livermore Valley are derived from two distinct low radioactivity source rocks. Consequently, the shallow Livermore Valley sediments have very low natural gamma radiation levels, with minimal sand/clay gamma ray contrasts. The commonly used 1" X 4" NaI scintillation crystal detectors generate inadequate counting statistics to provide reliable sand/clay discrimination or stratigraphic correlation. These conditions create detector instability and poor log repeat sections.

Slim-hole natural gamma ray log detector stability and log repeat section agreement at the Lawrence Livermore National Laboratory (LLNL) Livermore Site has been significantly improved by using larger gamma ray logging tools (1" X 8") NaI scintillation crystal detectors. The improvements obtained by doubling the scintillation crystal volume greatly exceeded those obtained by reducing the logging speed by a factor of two or lengthening the counting time windows. The LLNL Livermore Site experience in improving slim-hole gamma ray log reliability should be of value in other low radioactivity logging environments.

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